Comparison of the Effect of Intravenous Phenylephrine and Ephedrine on Pulse Rate in Treatment of Hypotension after Spinal Anesthesia

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Abstract

Hypotension is a side effect of the frequently used spinal anesthetic technique, which is employed in surgical procedures. Due to its quick onset, predictable and reliable block, and excellent postoperative analgesia, spinal anesthesia is frequently used in patients undergoing cesarean sections, gynecological surgery, urinary surgery, and orthopedic surgery of the lower limbs. Aim of study: to compare the effectiveness of intravenous phenylephrineand ephedrine on pulse rate in treatment of hypotension after spinal anesthesia. This study was performed in Ghazi Al-Hariri Hospital and Baghdad Hospital in Baghdad/Iraq about 4 month from 16 November 2022 to 2 March 2023. A total of forty patient: male were (17) patients and females were (23) patients twenty of them ephedrin and the rest phenylephrine. We study about 40 cases in different types of surgery the primary outcome measure was the change in pulse rate from baseline (every 2 min) to 10 minutes after drug administration.

The results of this study were ephedrine and phenylephrines when used to in treating hypotension, as both of drug effectiveness. But the results show that the pulse rate increases significantly from 6-12 mg dose in ephedrine, unlike phenylephrine, which leads to a decrease in the pulse rate.

We concluded that both phenylephrine and ephedrine when used to treating hypotension after spinal anesthesia, effected on pulse rate and they have differ in their mechanism of action and potential side effects than ephedrine.

Keywords: *phenylephrine, ephedrine, spinalanesthesia.*

مقارنة بين تأثيرالحقن الوريدي لدواء الفينيليفرين ودواء الإيفيدرين على معدل النبض في علاج أنخفاض ضغط الدم بعد التخديرالنخاعي

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الخلاصة

انخفاض ضغط الدم هو أحد الآثارالجانبية لتقنية التخديرالشوكي المستخدمة بشكل متكرر، والتي تستخدم في العمليات الجراحية. نظرًاللبداية السريعة، والمتوقعة والموثوق بها، والتسكين الممتاز بعدالعملية الجراحية، يتم استخدام التخدير النخاعي بشكل متكررفي

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المرضى الذين يخضعون لعمليات قيصرية، وعمليات الجراحة النسائية، وجراحة المسالك البولية، وجراحة العظام في الأطراف السفلية.

الهدف من الدراسة: مقارنة فعالية الفينيلفرين والإيفيدرين الوريدي على معدل النبض في علاج انخفاض ضغط الدم بعد التخدير الشوكي. أجريت هذه الدراسة في مستشفى غازي الحريري ومستشفى بغداد في بغداد / العراق في فترة اربعة اشهر تقريبا من 16 تشرين الثاني (نوفمبر) 2022 إلى 2 آذار (مارس) 2023. بلغ عدد المرضى أربعين مريضاً: الذكور (17) مريضاً والإناث (23) مريضاً، عشرين منهم اعطوا دواء الإيفيدرين والباقي اعطوا دواء الفينيليفرين. قمنا بدراسة حوالي 40 حالة في أنواع مختلفة من الجراحة، وكان قياس النتيجة الأولية هوالتغير في معدل النبض من خط الأساس (كل دقيقتين) إلى 10 دقائق بعد اعطاء الدواء.

وكانت نتائج هذه الدراسة أن دواء الإيفيدرين ودواء الفينيليفرين اللذان يستخدمان في علاج انخفاض ضغط الدم، واللذان لهما نفس الفعالية الدواء. ولكن أظهرت النتائج أن معدل النبض يرتفع بشكل ملحوظ من جرعة 6-12 ملجم في الإيفيدرين على عكس الفينيلفرين الذي يؤدي إلى انخفاض معدل النبض. تم استنتاج ان استخدام دواء الإيفيدرين ودواء الفينيليفرين عند استخدامه بعد التخديرالنخاعي له تاثير على معدل النبض وذلك من خلال اختلاف طريقة عمل و الاثار الجانبة لكل واحد منهم

الكلمات المفتاحية: *فينيليفرين، الإيفيدرين، التخديرالنخاعي.*

Introduction

Due to its rapid onset, predictable and reliable block, excellent postoperative analgesia, and lack of the most common risks associated with general anesthesia, such as aspiration and challenging intubation, spinal anesthesia is the method of choice for many operations, especially in the case of elective procedures.[1,2].

It is a secure and reliable type of anesthesia administered by anesthesiologists, licensed anesthesiologist assistants, and nurse anesthetists, and it is frequently used as an alternate to general anesthesia during procedures on the lower limbs and below the umbilicus. Spinal anesthesia (SA) frequently results in hypotension, which can happen in 16–33% of cases.[3,4].

The preganglionic sympathetic block causes hypotension. Patients experience hypotension as a result of vasodilatation brought on by spinal block-induced sympatholytic. It is believed that either a decline in systemic vascular resistance (SVR) or a reduction in cardiac output (CO) is to blame for the hypotension that follows the beginning of SA. An imbalance among vasodilatation and vasoconstriction is the primary cause of underlying hypotension related to spinal/epidural analgesia and occurs if the block is prevalent or in the presence of hypovolemia, even with a limited block. When a spinal block is performed, it causes vasodilatation within the region that is blocked and a reflex vasoconstriction in unblocked areas of the body in order to maintain blood pressure.[5,6].

Investigations on the treatment and prevention of post-spinal hypotension are ongoing. There are several ways to treat hypotension after spinal anesthesia, including giving intravenous fluids, using sympathomimetic medications like ephedrine and phenylephrine, and using mechanical

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techniques like elevating and compressing the legs to increase blood flow. But none of these management strategies can stop hypotension from happening.[7,8].

Ephedrine is a sympathomimetic, non-catecholamine substance that stimulates both beta and alpha adrenergic receptors. It exerts its effects by causing the discharge of norepinephrine via the autonomic nervous system. Although its superior efficacy to alternative vasopressors has not been proven, it is regarded as the preferred method of treating hypotension following spinal anesthesia, particularly for cesarean sections. However, its use has been limited because of its potential side effects, including supraventricular tachycardia, tachyphylaxis, and fetal acidosis in cesarean section [9,10].

Phenylephrine is an agonist of adrenergic receptors that increases venous return after sympathetic inhibition and produces vasoconstriction in a dose-dependent manner with greater effect on veins than arteries. Some of the negative consequences of phenylephrine include peripheral circulatory abnormalities in sensitive people, bradycardia, and fetal acidosis in pregnant women (to a lesser amount than ephedrine). There is little agreement on medication selectivity in recent research, despite the benefits of phenylephrine in the management of hypotension after spinal anesthesia.[11,12].

Patients and Methods

This study was carried out at Baghdad Hospital, Ghazi Al-Hariri Hospital, Baghdad / Iraq about 4 months from 16 November 2022 to 2 March 2023. Forty (40) adult patients (selective study) between (22-58) years old under spinal anesthesia were enrolled in this study. The patients were divided into two groups (each group of 20 patients) according to the drugs used (Ephedrine and Phenylephrine). As seventeen (17) males and twenty-three (23) as females with American Society of Anesthesiologists (ASA) physical status (I and II). The data and information were collected separately for each patient on a standard form. Which includes: name, age, sex, weight, type of operation, medication dosage and pulse rate (PR) in the first 10 minutes (every two minutes) after giving the medicine.

Pre-operation, medical history was recorded; conduct physical examinations and standard laboratory tests such complete blood counts, coagulation profile, electrocardiogram, blood sugar and liver function tests. In the operating room, the routine anesthesia machine check was performed before the start of surgery. Non-invasive blood pressure cuff, ECG, pulse oximeter probe were attached to the patient and initial blood pressure, pulse rate, respiratory rate, peripheral oxygen

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saturation were obtained and monitored throughout the entire surgery. Venous access was performed with an 18 or 20 or 22-gauge intravenous cannula and intravenous normal saline was initiated.

Lumbar puncture was performed under strictaseptic and antiseptic precautions and conditions by insertion of spinal needle at the level of L3-L4 or L4-L5 of the spinal column. All patients were received with marcaine spinal 0.5% heavy (5mg/ml) as the injection of spinal anesthesia, when their blood pressure decreased half of them received ephedrine (the dose given is 3 to 12mg depend on condition of the patient) and the rest received phenylephrine (the dose given is 50 to 100 mcg depend on condition of the patient).

Result

Table (1): The association between time and mean drug.

Time/min	Drug	Mean	Std.Diviation	*P_value*
baselinePR	**ephedrine phenylephrine**	**85.7500**	**19.58215**	**0.146 0.329**
PR2min	ephedrine phenylephrine	86.8500	18.12029	**0.350 0.332**
PR4min	ephedrine phenylephrine	88.2000	16.37585	**0.186 0.223**
PR6min	ephedrine phenylephrine	91.6000	17.67960	**0.306 0.164**
PR8min	ephedrine phenylephrine	91.4500	18.36322	**--- ---**
PR10min	**ephedrine phenylephrine**	**93.0500**	**19.77898**	**--- ---**

In the table (1) shows the mean and standard deviation of the PR and *P_value*in two groups, when measuring the heart rate of base line PR patients who were given ephedrine and phenylephrine, the mean was 85.75 and the standard deviation was 19.58, as the study found no significant difference. When measuring the heart rate of patients at PR 2min and they were given ephedrine and phenylephrine, the mean was 86.85 and the standard deviation was 18.12, as the study found no significant difference. When measuring the heart rate of patients at PR 4min and they were given ephedrine and phenylephrine, the mean was 88.2 and the standard deviation was 16.37, as the study found no significant difference. When measuring the heart rate of patients at PR 6min and they were given ephedrine and phenylephrine, the mean was 91.6 and the standard deviation was 17.67, as the study found no significant difference.

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When measuring the heart rate of patients at PR 8 min and they were given ephedrine and phenylephrine, the mean was 91.45 and the standard deviation was 18.36, as the study found no significant difference. When measuring the heart rate of patients at PR10 min and they were given ephedrine and phenylephrine, the mean was 93.05 and the standard deviation was 19.77, as the study found no significant difference.

Table (2): Distribution of sample study according dose of ephedrine.

Base line PR dose (mg) base line PR level cross tabulation							
Count							
		base line PR level					**Total**
		less than 64	**65-74**	**75-84**	**85-94**	**more than 95**	
Base line PR dose (mg)	3	1	2	3	2	7	**15**
	6	1	2	2	2	15	**22**
	9	0	0	0	0	1	**1**
	12	0	1	0	0	1	**2**
Total		**2**	**5**	**5**	**4**	**24**	**40**

In the table (2) shows the doses of ephedrine in relation to the heart rate, where the total number ofpatients who were given (3 mg) ephedrine were 15 patients, (6 mg) 22 patients, (9 mg) one patient, and (12 mg) two patients.

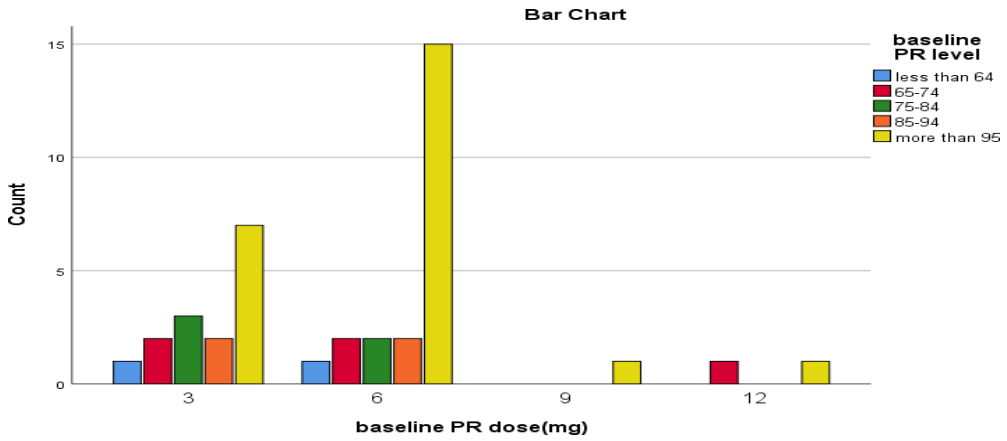

Fig. (1): Base line PR dose (mg) and base line PR level.

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Table (3): Distribution of sample study according dose of phenylephrine.

Base line PR dose (mg) base line PRl evel				
Count				
		Base line PR level		**Total**
		85-94	more than 95	
Base line PR dose (mcg)	50	0	6	**6**
	100	1	13	**14**
Total		**1**	**19**	**20**

In the table (3) shows the dose of phenylephrine to the heart rate at the first measurement, where the number of patients who were given (50 mcg) is 6 patients and the number of patients who were given (100 mcg) is 14 patients.

Discussion

The most frequent mechanism underlying hypotension related to spinal or epidural analgesia happens if the block is common or in a condition of hypovolemia, even with a limited block, and can result in reduced blood flow to vital organs like the heart and brain. Hypotension is a common side effect of spinal anesthesia. Several medication shave been used to treat hypotension after spinal anesthesia, including phenylephrine and ephedrine. However, the effectiveness of these medications in treating hypotension has not been well established in addition to their mechanisms of action, ephedrine and phenylephrine also have different clinical effects and side effect profiles in the treatment of hypotension. Ephedrine has been shown to increase heart rate, cardiac output, and blood pressure, making it a useful medication for treating hypotension associated with decreased systemic vascular resistance or decreased cardiac output. Phenylephrine, on the other hand, primarilycauses vasoconstriction and an increase in peripheral vascular resistance, making it a useful medication for treating hypotension associated with decreased systemic vascular resistance. Phenylephrine does not have any beta-adrenergic activity, so it does not increase heart rateor cardiac output. This can be beneficial in patients with pre-existing cardiac disease or in those at risk of arrhythmias [13,14].

The study found that both drugs when used in treating hypotension, Phenylephrine resulted in a significant lower pulse rate compared to ephedrine. Phenylephrine primarily affects arterial blood pressure by increasing systemic vascular resistance, while ephedrine increases both heart rate and blood pressure by increasing cardiac output and systemic vascular resistance, phenylephrine has been associated with an incidence of bradycardia, while ephedrine may cause tachycardia and palpitations, and this study agrees with[15- 17].

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Conclusion

Finally, we concluded that both phenylephrine and ephedrine have been shown to be effective in treating hypotension after spinal anesthesia. However, they differ in their mechanism of action and potential side effects.

Recommendations

The vasopressor medication choice depended on the patient's needs and surgery type, vasopressors use after spinal anesthesia must be carefully monitoring to avoid the danger of side effects such as arrhythmias tachycardia, and myocardial ischemia.

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